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When Multinationals Leave: A CGE Analysis of the Impact of Divestments

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Abstract

Most studies on Multinational Enterprises (MNEs) focus on the impact of their expansion through inward or outward foreign direct investment (FDI) flows. However, divestments are quite common among the operations of MNEs. In order to derive their effects, we build a computable general equilibrium (CGE) model that includes two non-standard characteristics: the presence of MNEs and unemployment. The model is applied to the Spanish economy, where FDI inflows have surpassed divestments at the aggregate level in the period 2005-2009, although divestments have been sizeable in ten sectors. We analyse two different scenarios: 1) divestments that involve the closure of plants of foreign affiliates and 2) divestments where national firms buy the plant of foreign affiliates. The model allows estimating the overall impact of the divestments occurring simultaneously in ten sectors and in particular sectors. Results not only show that national acquisitions are less harmful than closures, but quantify those effects, and provide information on the role of the divesting sector. Some adjustment costs arise in all scenarios.

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Keywords FDI, disinvestments, closures, national acquisitions, Spain

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1 Introduction

Most studies on Multinational Enterprises (MNEs) focus on the impact of their expansion through inward or outward foreign direct investment (FDI) flows, and foreign outsourcing or offshoring. Barba Navaretti and Venables (2004) and Feenstra (2010) present a review of their theoretical and empirical effects on host and home countries. However, MNE divestments are common operations: "[They] affect between one quarter and four fifths of all FDI projects" (UNCTAD 2009: 8). This phenomenon becomes more important in times of crisis and high unemployment (UNCTAD 2012: 62–63), but is not limited to those times. Bernard and Jensen (2007) point out the abundance of plant shutdowns across manufacturing firms in the US, of which MNEs account for around one fifth of subsequent employment destruction. Ibarra-Caton (2012) shows that US manufacturing plants of foreign MNEs are more likely to shut down than non-MNE plants (although less likely to shut down than US-owned MNE plants). Thus, it seems that divestments are an important side of the operations of MNEs, although the evidence in the literature is scant.

Boddewyn (1983) suggests that divestment can be treated as the reverse process of FDI under certain circumstances. When the advantages of internalisation or location cease for MNEs, the absence of barriers to exit may favour divestments. This transitory nature of FDI in advanced economies could well explain divestments as long as the emerging and transition economies become more attractive for MNEs (e.g. because of lower labour costs and EU membership). In 2010, developing and transition economies attracted half of worldwide FDI inflows (UNCTAD 2011). UNCTAD itself regards this as a record figure, since these countries used to receive around one third of the world's FDI inflows. China explains most of this trend because it is the top destination of FDI flows. However, in 2010 there were already ten developing and transition economies among the top 20 recipients of inward FDI. In contrast, developed economies have undergone divestment processes, particularly Japan and some European countries (UNCTAD 2011 and 2012).

The consequences of divestment on employment volatility are not clear, as stated by Barba Navaretti and Venables (2004). There may be two reasons why employment could have a different degree of volatility in MNEs than in national firms. Firstly, MNEs have a different degree of exposure to international shocks

than national firms. MNEs are more sensitive to technological and price shocks, which would shift their downward-sloping labour demand schedules. Secondly, MNEs have lower costs of relocation than national firms because they operate with several plants (e.g. when a change in the home wage rate takes place, the elasticity of labour demand can be higher for MNEs than for national firms). The theoretical effect of MNEs on employment volatility is ambiguous and depends on several factors: a complementarity or substitutability relationship between employment in the host country and factors of production in other locations, commitment to local institutions, labour and product elasticities of demand and production factor intensities, etc. Nevertheless, the empirical evidence shows that when a demand shock takes place, MNEs adjust their employment quicker than national firms, although they are more likely to retain their employees (see, for example, Görg and Strobl 2003; Barba Navaretti et al. 2003).

The lack of a clear theoretical framework for model divestment makes it suitable for simulation models to test plausible scenarios. For this reason, we analyse the case of Spain, a developed economy that has been heavily affected by the financial crisis and experienced a huge increase in unemployment rate (from 8% in 2007 to 26% in 2013). Total FDI net inward flows have been positive in Spain (i.e., the entry of FDI surpasses FDI divestments). However, in some sectors divestments have been greater than the entry of FDI flows. We use a simulation model – a computable general equilibrium (CGE) model – which allows us to follow the differential impact of divestments depending on the sector in which they occur. We also estimate the effects of all simultaneous divestments for the economy as a whole. This CGE model is one of the few that accounts for the operations of MNEs. It is further extended to include unemployment, a feature that to the best of our knowledge has not yet been included in any of the CGEs with MNEs (see Latorre 2009, for a review). Unemployment effects seem crucial for the analysis of divestments. We further have developed a social accounting matrix (SAM) for the Spanish economy for the year 2005. This database has been completed with FDI and MNE Spanish data.

The present paper is organised as follows. The next section includes worldwide evidence on the recent trends of the operations of MNEs. Section 3 focuses on the description of the divestments that have taken place in Spain from 2005 onwards. Section 4 explains the CGE model for multinationals, while section

5 discusses the main results. Section 6 presents a sensitivity analysis. The conclusions appear in the last section.

2 Worldwide Evidence on MNEs Employment

OECD (2012a) provides data on the MNE employment across various OECD member countries, summarised in Table 1. The data refer to the activities of MNEs in all manufacturing sectors (data on the primary sector and services are poorer and have not been included). The first two columns show the number of employees in MNEs in 2001 and 2007. The third column gives the percentage variation in the number of employees between those two years. Countries are ordered in the table according to this percentage variation.

The countries that have experienced sizeable increases in the number of MNE employees are at the top of Table 1. Most Eastern European countries are in this group. However, there are advanced economies as well, such as Denmark, Switzerland and Austria. A second group of countries experienced modest increases in MNE employment. Finally, countries which experienced MNE employment reductions are at the bottom of the table. Such reductions were sizeable in Ireland, the Netherlands, Norway, Italy, United States and France. One hypothesis is that these losses in employment could be due to technological progress. Advances in technology taking place within a MNE, on the whole, tend to be available to different countries. However, these data show that employment grew in some countries but declined in others. It seems that other factors must be at play (e.g. cost savings and EU membership) when deciding whether or not to hire more workers in a particular country. For example, the relatively expensive low-skilled manufacturing employees in advanced countries have decreased in number and a plausible explanation is the offshoring process in emerging economies (see, for example, Feenstra (2010) and Yamashita (2010), for a description of the US and Japanese cases). The effect of investment creation and diversion when transition economies enter the EU also seems plausible according to Table 1: MNE employment increased in new EU entrants, such as Poland, Czech Republic, Slovak Republic, Hungary and Slovenia, whereas it decreased in

Table 1: MNEs and employees in manufacturing sectors (2001–2007)

	No employees in MNEs			*Share of MNEs in Manufacturing*		
	2001	**2007**	**% 2001-7**	**2001**	**2007**	**Difference 2001-7**
Sizeable Increases						
Poland	386003	658021	70.5	21.9	32.5	10.6
Czech Republic	362423	564543	55.8	28.9	45.5	16.6
Denmark	65800	83006	26.1	14.1	22.6	8.5
Slovak Republic*	143482	180019	25.5	34.9	43.8	8.9
Hungary*	230402	287296	24.7	27.1	36.9	9.8
Switzerland*	119025	145345	22.1	11.6	13.6	2
Estonia*	41078	49333	20.1	38.4	45	6.6
Slovenia*	37129	42977	15.8	15.9	18.7	2.8
Austria*	n.a.	179141	n.a.	24	29.1	5.1
Small increases						
Germany*	1086000	1144000	5.3	14.8	16.5	1.7
Luxembourg*	13800	14400	4.3	41.7	44.3	2.6
Israel	44412	46402	4.5	n.a.	n.a.	1.6
Belgium*	n.a.	n.a.	n.a.	32.3	34.8	2.5
Finland	73450	74169	1.0	17.2	19.2	2
Decreases						
Ireland	123186	102439	-16.8	49.2	46	-3.2
Netherlands*	210116	176445	-16.0	21	24.3	3.3
Norway	70388	60944	-13.4	24.3	22.4	-1.9
Italy	520749	456987	-12.2	10.8	10.1	-0.7
United States*	2330200	2050700	-12.0	11.1	11.3	0.2
France*	1043400	938151	-10.1	26.4	26.1	-0.3
Spain	408579	386041	-5.5	16.4	16.1	-0.3
United Kingdom	906237	859110	-5.2	24	30.4	6.4
Sweden	232579	221744	-4.7	32.7	33.4	0.7
Portugal*	108366	108046	-0.3	12.8	13.3	0.5

Source: OECD (2012a). Note: For countries with an asterisk, the data on MNEs exhibit breaks in the series yielding a shorter time series. The periods for which data are available are 2003–2006 for Slovak Republic, Hungary, Estonia, Slovenia and Portugal; 2002–2007 for Austria and France; 2002–2005 for the Netherlands and Israel; 2001–2005 for Luxembourg, 2002–2006 for Belgium and Germany; 2001–2006 for the US and 2003–2007 for Switzerland.

former EU member countries, such as the Netherlands, Italy, France, UK, Spain and Portugal. Baldwin et al. (1996) and Bajo-Rubio and López-Pueyo (2002), for example, examine this relationship between FDI and economic integration.

The evolution in the number of employees in MNEs can be compared with the same variable in national firms. This is shown in the next three columns in Table 1. They display the share of employees in MNEs with respect to total employees in manufacturing. All the countries that increased the number of employees in MNEs also experienced an increase in their share of MNEs. This implies that MNEs created more employment than national firms.

There are different trends among the countries that reduced employment in MNEs. On the one hand, Ireland, Norway, Italy and France decreased the share of MNEs in total employment. On the other hand, that share increased in the Netherlands, the US, United Kingdom, Sweden and Portugal.

These changes in employment suggest that MNEs can play a key role in employment creation or destruction in OECD countries. We focus on the case of Spain, where aggregate employment creation had been sizable before the crisis. The Spanish Economically Active Population Survey shows a 29.1% growth in the number of employees and self-employed for the period 2001–2007 for the economy as a whole.

3 Divestments in the Spanish Economy

For decades Spain has been an attractive country for the activities of MNEs (Bajo-Rubio and López-Pueyo 2002). However, as explained in the Introduction, FDI projects can be affected by divestments. Myro et al. (2008) provide a wide ranging overview of divestment processes in manufacturing in Spain.

MNEs account for an important share in manufacturing: around 16% of their employees (Table 1). This is also the case in services, with 7% in production in 2005 and nearly 10% in 2009 (INE 2013a; Eurostat 2013; OECD 2012b). Spain experienced an important boom in FDI inflows before joining the European Community in 1986. It also became an important source of FDI outward flows (Guillén 2005; Guillén and García-Canal 2010), with world leading MNEs in services (Santander, BBVA, Telefónica, etc.), infrastructure (e.g. Grupo Ferrovial and ACS), energy (Repsol and Iberdrola) and clothing (Zara, Mango, etc.).

According to the World Investment Report, Spain has been among the top ten largest sources and recipients of FDI in the world in the past few years.

The Spanish Registry of FDI (Ministry of Economics and Competitiveness 2013) has a dataset which enables the analysis of the movements of inward and outward FDI. This source therefore allows us to estimate divestment flows. A caveat on the use of divestments data is how to avoid including operations that are not strictly related to reductions in production or employment. For example, this is the case for reverse intra-company loans, or the repayments of debts to the parent company. These cases appear in many sources as a divestment, but the Spanish Registry of FDI data allows disentangling them from the sectoral data on transmissions to other owners (e.g. a national acquisition of a foreign plant), and from partial and total closures. Unfortunately, this information is usually not available at sectoral level from other sources, such as the OECD, UNCTAD and Eurostat.

A related issue is how to measure the level of foreign capital stock or "net FDI position". The series on FDI from the Spanish Registry of FDI gives the equity capital component at sectoral level. This contrasts with the information from other institutions, such as the Bank of Spain, Eurostat and the OECD that do not permit the extraction of the equity capital component at sectoral level. In this study, we concentrate on divestments proxied by the impact of reductions in equity capital (excluding reinvested earnings and other capital). We take as reference for our model the FDI position in 2005, for the sake of coherence with the rest of the dataset (see Section 4.8).

Table 2 summarises the calculations of the variations in the net FDI position. The net FDI position for the economy as a whole (labelled in row TOTAL in Table 2) increased by 35.57% in the period 2005–2009. In the pre-crisis period (2005–2007) the growth of foreign capital was 12.85%. Thus, the Spanish economy has been attracting foreign capital. Note that Spain, in this model, has been split into 22 sectors described in Appendix I. In some of those 22 sectors, divestments prevail over FDI inflows received. As a consequence, there was a fall in the net FDI position. The magnitude of the decreases is important and, as shown in Table 2, they occurred before the crisis (with the exception of "Textiles" and "Activities auxiliary to financial intermediation"). However, in six out of the ten sectors considered, the crisis exacerbated divestments.

Table 2: Changes in the net FDI position in Spain

	2005-7%	2005-9%
Beverages & Tobacco	-61.46	-36.46
Textiles	27.25	-28.39
Fabricated metal products	-5.62	-4.90
Motor vehicles, trailers & semi-trailers	-4.86	-22.51
Sale & repair of motor vehicles	-14.99	-25.87
Air and water transport	-15.36	-32.65
Telecommunications	-18.98	-36.11
Activities auxiliary to financial intermediation	0.95	-3.49
Renting of machinery & equipment	-34.37	-48.97
Other business activities	-22.21	-17.40
TOTAL	12.85	35.57

Source: The Spanish Registry of FDI (Ministry of Economy and Competitiveness 2013)

Table 2 includes only the sectors where divestment has taken place. It includes all the divestments in the Spanish economy at sectoral level, except for two small sectors – the Primary sector and Other manufacturing. Given the small size of these two sectors, we do not expect to find important effects for the economy as a whole. Thus, our simulations will cover the effects arising from the sectors included in Table 2.

In order to simulate divestments we need to consider some additional information. The World Investment Report (UNCTAD 2009) states that between one-fourth and one-third of all cross-border mergers and acquisitions involve the disposal of foreign affiliates to other firms. The buyer may be a firm based (1) in the economy previously hosting the affiliate, (2) in the home economy or (3) in a third country. Case 1 results in a reduction of the net FDI position in the host economy (i.e., a divestment), whereas cases 2 and 3 do not have any implication for the net FDI position (i.e., they are not registered as divestments).

According to the World Investment Report, in most cases a firm based in the host economy buys the affiliate. The next most common case is the purchase from a firm based in a third country, and the least frequent case is a purchase from a

firm based in the MNE's home economy. If a national firm buys the plant of a foreign affiliate, the plant would continue its operations under a different ownership but, usually, experience a reduction in employment. At the other extreme, divestments may imply the closure of plants of foreign affiliates, leading to more drastic employment outcomes. In our study, we analyse these two types of divestment across different sectors of the Spanish economy.

The Spanish Registry of FDI provides data on the relative importance of divestments of MNEs involving the closure of firms versus those divestments that ended up in the acquisition of the foreign affiliate by a national firm. There is no public information at sectoral level, but only for the economy as a whole. Table 3 shows that closures account for a smaller share of divestments (the weighted average for the period 2005–2011 is 20.3%), while national acquisitions account for the reminder. In the present study, we simulate both closures and national acquisitions. This provides the two extreme hypotheses between which the impact of divestments must be placed. Nevertheless, it seems that the effect is likely to be closer to the outcomes derived from national acquisitions.

Table 3: Closures and national acquisitions in divestments in Spain

	2005	2006	2007	2008	2009	2010	2011	Average
Percentages								
Closures	27.4	9.8	10.1	20.6	35.0	31.2	7.9	20.3
Total closure	5.5	1.0	5.7	8.0	5.5	7.1	3.6	5.2
Partial closure	21.9	8.8	4.4	12.6	29.5	24.1	4.3	15.1
National acquisitions	72.6	90.2	89.9	79.4	65.0	68.8	92.1	79.7
Total	100	100	100	100	100	100	100	100.0
Millions of euros								
Closures	1790	990	1031	776	738	896	131	907
Total closure	358	105	585	301	116	204	60	247
Partial closure	1432	885	446	475	622	692	71	660
National acquisitions	4753	9095	9183	2989	1368	1980	1520	4413
Total	6543	10085	10214	3765	2106	2876	1651	5320

Source: The Spanish Registry of FDI (Ministry of Economy and Competitiveness 2013)

4 The Model and Simulations

The model is an extension of Gómez-Plana and Pascual (2011). It adds MNEs differentiated from national firms, and also includes FDI changes. It is a static computable general equilibrium model describing an open economy, disaggregated into 23 productive sectors (see Appendix I), one representative consumer, the public sector and a foreign sector representing the rest of the world. The extension of the model addresses four factors: (1) the split of each productive sector into two parts - one representing the firms owned by residents, and the other foreign-owned firms; (2) the modelling of capital use according to specific factor assumptions; (3) the definition of the sectors according to the adjustment that will take place after the divestments; and (4) the assertion that public sector policies are exogenous to focus on effects generated by the private sector.

The model differs from the existing literature on CGE models with MNEs in its way of modelling MNE technologies. Jensen and Tarr (2012) extend previous contributions (Jensen et al. 2007; Rutherford and Tarr 2008) to consider a multi-regional framework. They include a Dixit-Stiglitz-Ethier formulation, which leads to potential increases in consumers' welfare and producers' productivity through a higher number of product varieties (i.e., more firms producing those services, due to the arrival of MNEs). However, apart from their use of an imported intermediate, MNEs' technology is the same as that in national firms operating in the same sector.

Lakatos and Fukui (2013) have built a multiregional CGE model with MNEs. They have also constructed a database on foreign affiliates' sales for the whole world with high sectoral detail (Fukui and Lakatos 2012)[1]. The differentiation of the technologies of MNEs and national firms within each sector in the CGE is based on the MNEs' shares in sales and on a proxy for differences in capital-labour ratios for the two types of firm. Lakatos and Fukui (2013) do not differentiate the value added provided by both types of firm which is assumed to be proportional to sales, so that they introduce a further degree of symmetry

[1] In our view, the main contribution of this database is that it provides information on the sales of MNEs in many countries and sectors for which formerly there was no information at all.

between national firms and MNEs. We use the real shares on value added and production, which enable us to identify differences in productivity.

These recent CGE approaches reflect a trade-off between expanding a model's regional coverage and differentiating technologies of national firms and MNEs across sectors. Further, these models capture the impact of MNEs by relying on barriers to FDI in order to make FDI movements endogenous. Those barriers are difficult to estimate empirically. By contrast, in our model, we use real data on the variations of the FDI net position across sectors and derive their impact.

Finally, it must be noted that due to the high unemployment rate in the Spanish economy, instead of using the common assumption of full employment in the labour market, the model includes unemployment in a way derived from trade union models. Next we present a brief description of the model. The full set of equations is given in Appendix II.

4.1 Equilibrium Conditions

The equilibrium of the model is a set of prices and allocation of goods and factors. It involves the simultaneous solution of three sets of equations:

- Zero-profit conditions.
- Market clearing in goods and capital markets.
- Constraints on disposable income (total revenue must equal total expenditure), labour market (includes unemployment) and macroeconomic closure of the model.

4.2 Production

Production is based on a technology characterized by a nested structure of intermediate inputs, capital and labour. The firms' problem is to maximise profits subject to technology constraints, obtaining the unit cost functions, which are further used in the zero-profit conditions. In turn, the demand for factors and intermediate inputs are obtained from Shepard's lemma on cost functions, and then used in the market-clearing equations.

Firms show constant returns to scale in their technologies and fix a competitive pricing rule, with free entry and exit of firms. However, note that within each

sector there are two different varieties of the same good: a national variety produced by national firms and a foreign one produced by MNEs. The price of these two varieties can differ because their costs of production vary between national firms and MNEs of the same sector. Thus, we abandon the assumption of equal costs of production for national firms and MNEs across sectors, which is present in most of the CGEs including MNEs (see Latorre 2009 and 2010). This equal costs assumption arises because only the percentage of capital owned by MNEs is used to split the sectors into a national firms' part and another MNEs' part. Thus, the input mix is the same between both types of firm within the same sector. By contrast, in our model, we split sectors into two parts, using Eurostat's information on the shares of production, labour and capital that MNEs and national firms own (see Section 4.8). As a result, the cost structure differs between national firms and MNEs in each sector.

4.3 Consumption

There is a representative consumer household behaving as a rational consumer. The level of consumer welfare is determined by the endowments of capital and labour jointly with exogenous net transfers paid by the public sector. The fixed endowment of labour should be interpreted as a maximum supply, since leisure and unemployment are assumed to be endogenous. Hence, labour supply would be elastic up to the endowment constraint.

The problem of household decisions consists of choosing an optimal consumption bundle, by maximising a nested utility function subject to budget constraint. Preferences are represented by a nested utility function on (consumption of) goods, leisure and savings. Notice that, given our static approach, we assume a unitary elasticity of substitution between savings and (consumption of) goods (Howe 1975), so that savings can be interpreted as the purchase of bonds for future consumption.

The budget constraint includes total factor rents jointly with exogenous net transfers paid by the public sector. Demand functions for goods, leisure and savings are derived from the first-order conditions, and are included in the equations for goods and factor markets, as well as in the macroeconomic closure for savings.

4.4 Public Sector

The role of the public sector in the model is twofold, i.e., owner of resources (e.g. from capital endowment and tax revenue), and purchaser of certain goods. As a resource owner, its wealth includes income from capital rents, net transfers paid to the representative household, and tax revenues. Taxes consist of social contributions paid by employers and employees, value added taxes, other net indirect taxes, and income taxes. All taxes are modelled as effective *ad valorem* rates calibrated from benchmark data, except for income taxes that are exogenous. In order to isolate any bias from the public sector on the results, *ad valorem* indirect tax rates are allowed to change endogenously under the equal yield assumption.

Capital rents for the public sector, by definition (see Eurostat 1996), include the fixed capital consumption because net operating surplus is zero for the public sector. The fixed capital consumption has been assigned to two sectors: “Public services” and “Other services”. All the capital in “Public services” is owned by the public sector, whereas in “Other services” it is partly publicly owned and partly private.

The public sector also enters the model as a purchaser. Public sector expenditure includes both market (i.e., output that is disposed of in the market at economically significant prices) and non-market goods (i.e., output that is provided at prices that are not economically significant).

4.5 Foreign Sector

The model incorporates the small open economy assumption. It means that the country faces a perfectly elastic export supply function. In addition, there is a constant elasticity of transformation function between domestic and foreign sales. Regarding imports, we assume that goods are differentiated according to their origin (i.e., domestic or foreign), following Armington’s assumption (Armington 1969), which allows for the possibility of intra-industry trade despite the assumption of exogenous world prices.

The foreign sector is closed by assuming that the difference between receipts and payments from the rest of the world is exogenous. This constraint would prevent, for example, a permanent increase in exports with no change in imports,

an unlikely scenario since it would involve an unlimited capital outflow from the country. Nevertheless, it forces a matching movement in trade flows.

4.6 Factor markets

Two factors are incorporated into the model: capital and labour. With respect to capital, both the representative household and the public sector own fixed endowments. The capital rents adjust to clear the domestic capital market, under the assumptions of capital international immobility (except for the divestments, which have been modelled as exogenously driven), and no mobility across domestic sectors. Hence the capital is specific at two levels: (1) each sector employs only specific capital, and (2) capital is differentiated according to ownership (i.e., public, private national and foreign).

The only owner of labour is the representative household. The demand for leisure is derived from the household's optimisation problem. Hence, labour supply (i.e., labour endowment minus the demand for leisure) would be elastic up to the fixed amount of labour. We assume that labour is internationally immobile, but mobile within the country.

We also assume that workers have some market power and their wage demands are related to unemployment level in the economy (Kehoe et al. 1995). For that reason the model includes the following constraint:

$$w = \left(\frac{1-u}{1-\bar{u}} \right)^{1/\beta}$$

where w represents real wages, u is the unemployment rate at the benchmark value, and β is a parameter that measures real wage flexibility with respect to the unemployment rate. Hence, when β approaches infinity, the real wage approaches its benchmark value (which is 1 according to the calibration process explained below). This is the case for rigid real wages when wages do not change when unemployment does. If β approaches zero, the unemployment rate approaches the benchmark unemployment rate, with real wages being flexible. Intermediate values for β show different flexibility levels of real wages to the unemployment rate.

4.7 Macroeconomic Closure

Total investment is split into sectoral gross capital formation using a fixed-coefficients Leontief structure (Dervis et al. 1981). Notice that, in our static framework, total gross capital formation shows its influence on the economy as a component of final demand. The model embodies a macroeconomic closure equation stating that investment and savings (private, public and foreign) are equal.

Finally, the model is solved as explained in Rutherford (1999), with the general equilibrium model defined as a mixed complementarity problem (see Mathiesen 1985). The software employed is GAMS/MPSGE.

4.8 Calibration and Data

The model has been calibrated with Spanish data. The calibration method is based on a benchmark equilibrium corresponding to the National Accounts and a set of exogenous parameters. A detailed explanation for the calibration method can be found in Mansur and Whalley (1984) and Dawkins et al. (2001).

To build the Social Accounting Matrix (SAM) we rely on the 2005 Input-Output symmetric table, the most recent available for the Spanish economy. We also use information on the institutional sector accounts from the Spanish Instituto Nacional de Estadística (INE 2013b). Public revenue data have been disaggregated for indirect taxation, and social security contributions. The sector disaggregation in the SAM includes[2] first the ten sectors that register divestments (see Table 2). Another set of sectors has been chosen for their upstream and downstream linkages with the ten disinvesting sectors. And there are two other aggregate sectors, ("Other industries" and "Other services"), which cover the remaining sectors.

Elasticities play a key role in the model (see sensitivity analysis in Section 6). The benchmark values for those elasticities are:

- Elasticities of substitution in the welfare function
  - — between consumption and savings (σCA): 1

[2] The Input-Output table has 72 sectors aggregated into 23 sectors. See Appendix I.

  - between final consumption and leisure (σCO): 1
  - among final consumption goods (σ*BC*): 1

- Elasticities related to production
  - between intermediate inputs and value added composite (σI): 0
  - between labour and capital (σLK): values fluctuate between 0.20 and 1.68
  - between domestic and foreign goods (Armington elasticities): values fluctuate between 1.25 and 4.05
  - between goods sold in the domestic market and abroad (elasticities of transformation): values fluctuate between 0.70 and 3.90

The literature sources for the elasticities are Narayanan and Walmsley (2008) for σ*LK* and σ*A*; the elasticities of transformation from De Melo and Tarr (1992); and σ*CO* is consistent with the survey by Ballard and Kang (2003). The remaining values are widely found in the literature.

The sectoral data (on production, employment and factor rents) are split between national firms and MNEs. Most of the information for those shares comes from Eurostat (2013), with few exceptions. Data on the financial sector come from the Bank of Spain (2006a) and Asociación Española de Banca (2006). As there are no data on the construction sector for 2005, we use data for 2008, the first available year in Eurostat (2013). Data on agriculture come from the SABI (2012) database.

4.9 Simulations

Two broad types of simulation are run. First, a set of simulations investigates the impact of divestments, leading to the closure of foreign firms ("Closure" hypothesis). The closure (total and partial) is represented as a decrease in sectoral capital stock owned by foreigners in Spain. Second, other simulations consider the effects of the acquisition of foreign plant by national firms ("National acquisition" hypothesis). The sales to national firms involve a change in ownership and the capital moves from foreign to national firms.

National acquisitions are more common and account for approximately 80% of the divestments (Table 3). However, we do not know the distribution of closures and national acquisitions at sectoral level. Thus, we will simulate the two extreme

scenarios to establish the range for these results. The values of divestments, in real terms, cover the period 2005–2009 (Table 2).

For the "National acquisition" scenario one question arises in a general equilibrium framework: how did Spanish firms finance the purchase of foreign affiliates? To the best of our knowledge, there is no accurate information on this issue. We know, however, that since 2003 most Spanish MNEs that acquired other firms abroad did so through loans (Bank of Spain, 2011). In those years credit was easily available at very low interes t rates. INE (2013b) data show that non-financial firms became increasingly indebted from 2003 to 2007, while the pace of indebtedness was reduced but still present in 2008–2009. Further, the Bank of Spain (2006b) and the European Central Bank (2006) confirm that for that period much of the demand for credit was related to mergers, acquisitions and firms' restructuring. It seems reasonable, therefore, to assume that national firms were given loans in order to purchase the foreign affiliates located in Spain. This is taken into account in the simulations.

5 Results

The scenarios "Closure" and "National acquisition" are presented for two cases: (1) the general equilibrium effects of simultaneous divestments in the ten sectors where divestment takes place – labelled "All divestments" for both scenarios (Section 5.1). (2) the general equilibrium effects of divestment in individual sectors, discussed for each of the ten sectors where divestment takes place (Section 5.2). Both cases reproduce the divestments *actually* experienced in Spain between 2005 and 2009. Due to the static character of our model, the results should be viewed as short/medium-run outcomes.

5.1 The impact of the Simultaneous Divestments in All Divesting Sectors

Figure 1 summarises the main findings for our two extreme hypotheses ("Closure" and "National acquisition"). With respect to "Closure", foreign capital leaves the country and workers in foreign affiliates are dismissed. Around 1.5% of the total

employment in the economy disappears. The unemployment rate rises by 11% (i.e., from its level in 2005, 9.16%, to 10.16%). As labour demand decreases, real wage falls. The lower labour demand (and employment) also brings about lower capital demand. This lower capital demand, together with the fall in capital supply (i.e., of the amount of divestment), generates a smaller reduction in the remuneration of capital than that in wages: 0.13% (rental rate of capital is a sectoral weighted average, given the capital specific assumption).

The fall in the factors employed in production and their lower remunerations result in a decrease in both GDP and welfare (measured as Hicksian equivalent variations) of 1.45% and 1.70%, respectively. Since the level of activity diminishes due to the closure of plants, foreign trade shrinks as well.

Next we analyse the scenario where all the former foreign plants end up in the hands of national firms ("National acquisition"). Under this hypothesis, the unemployment rate will decrease by 3.55% (from 9.16% to 8.83%). Total employment in the economy rises by 1%. Capital is now used in national firms, whose technology is slightly more labour intensive in aggregate than that in the MNEs (see Figure 2 for sectoral detail). The general increase in labour generates a Stolper-Samuelson-theorem effect on factor rents: an increase in wages with

Figure 1: Simulations results: effects of all divestments

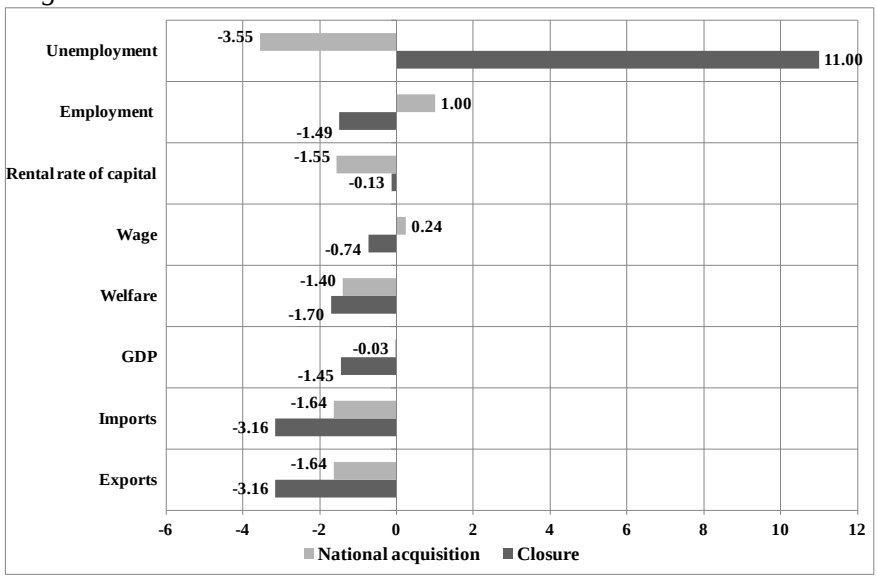
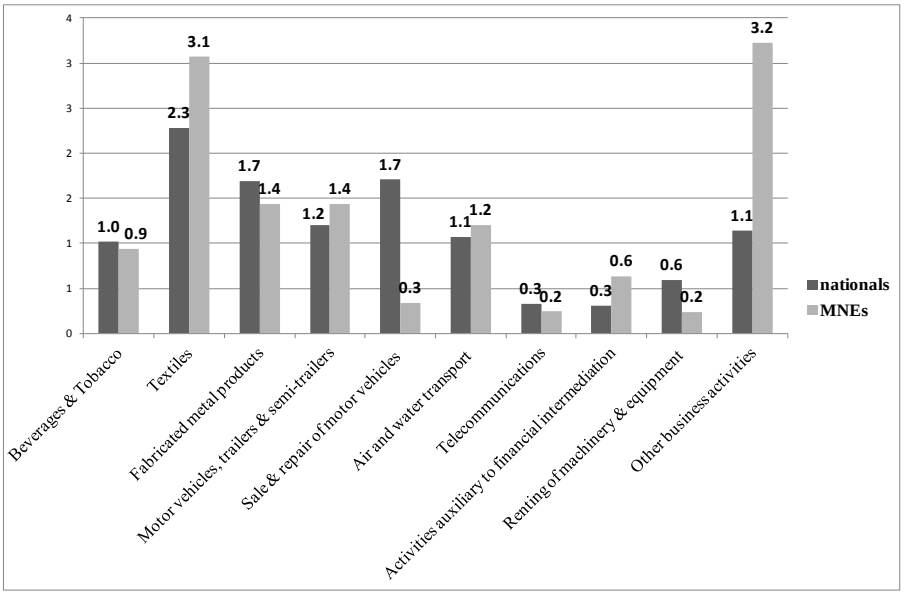


Figure 2: Labour intensity (L/K ratio) across the ten sectors with divestments



respect to capital rents. The real rental rate of capital goes down by 1.55%, while wages grow by 0.24%. However, the positive effects for employment in the economy do not push GDP up. It remains practically at the same level (0.03%), due to a capital rent fall.

Welfare decreases under this "National acquisition" hypothesis. The representative household experiences a decrease in the remuneration of capital. Therefore, the pronounced fall in the rental rate of capital is harmful to the consumer. Foreign trade diminishes when national employers, compared to MNE ownership, buy more firms. Logically, the fall in trade is smaller than in the "Closure" scenario.

5.2 Sectoral Differences in the Impact of Divestments

We analyse the effects of divestments for each sector in turn (see disinvesting sectors in Table 2). The results of these simulations appear in Table 4 ("Closure" hypothesis) and Table 5 ("National acquisition" hypothesis).

Table 4: Simulations results: effects of "Closures" across sectors

	Employment	Unemployment	Wage	Rental rate of capital	GDP	Welfare	Imports	Exports
Beverages & Tobacco	**-0.17**	1.22	**-0.08**	**-0.06**	**-0.12**	**-0.18**	**-0.20**	**-0.20**
Textiles	**-0.02**	0.14	**-0.01**	0.00	**-0.02**	**-0.02**	**-0.01**	**-0.01**
Fabricated metal products	**0.00**	0.02	**0.00**	0.00	**0.00**	**-0.01**	**0.00**	**0.00**
Motor vehicles, trailers & semi-trailers	**-0.46**	2.96	**-0.20**	0.14	**-0.35**	**-0.42**	**-1.96**	**-1.96**
Sale & repair of motor vehicles	**-0.16**	1.41	**-0.09**	**-0.07**	**-0.23**	**-0.25**	**-0.45**	**-0.45**
Air and water transport	**-0.01**	0.22	**-0.01**	**-0.06**	**-0.05**	**-0.11**	**-0.10**	**-0.10**
Telecommunications	**-0.36**	2.85	**-0.19**	**-0.12**	**-0.41**	**-0.43**	**-0.51**	**-0.51**
Activities auxiliary to financial intermediation	0.06	**-0.17**	0.01	**-0.12**	**-0.02**	**-0.15**	**-0.14**	**-0.14**
Renting of machinery & equipment	**-0.13**	1.34	**-0.09**	**-0.13**	**-0.23**	**-0.39**	**-0.25**	**-0.25**
Other business activities	**-0.11**	0.94	**-0.06**	**-0.08**	**-0.14**	**-0.34**	**-0.19**	**-0.19**
All Divestments (closures)	**-1.49**	11.00	**-0.74**	**-0.13**	**-1.45**	**-1.70**	**-3.16**	**-3.16**

Table 5: Simulations results: effects of "National acquisition" across sectors

	Employment	Unemployment	Wage	Rental rateof capital	GDP	Welfare	Imports	Exports
Beverages & Tobacco	**0.00**	0.11	**-0.01**	**-0.05**	**-0.02**	**-0.03**	**0.00**	**0.00**
Textiles	**0.00**	0.02	**0.00**	**-0.01**	**-0.01**	**-0.01**	**-0.01**	**-0.01**
Fabricated metal products	0.01	**-0.02**	0.00	**-0.01**	**0.00**	**-0.01**	**-0.01**	**-0.01**
Motor vehicles, trailers & semi-trailers	**-0.21**	1.48	**-0.10**	**-0.08**	**-0.19**	**-0.25**	**-1.25**	**-1.25**
Sale & repair of motor vehicles	1.04	**-4.78**	0.32	**-1.04**	0.26	**-0.86**	**-0.35**	**-0.35**
Air and water transport	0.54	**-1.61**	0.11	**-0.99**	**-0.11**	**-1.22**	**-1.08**	**-1.08**
Telecommunications	0.38	**-0.46**	0.03	**-1.06**	**-0.27**	**-1.37**	**-1.28**	**-1.28**
Activities auxiliary to financial intermediation	0.61	**-1.94**	0.13	**-1.05**	**-0.09**	**-1.28**	**-1.13**	**-1.13**
Renting of machinery & equipment	0.71	**-2.39**	0.16	**-1.18**	**-0.07**	**-1.27**	**-1.12**	**-1.12**
Other business activities	0.39	**-0.58**	0.04	**-1.02**	**-0.23**	**-1.48**	**-1.20**	**-1.20**
All divestments (national acquisitions)	1.00	**-3.55**	0.24	**-1.55**	**-0.03**	**-1.40**	**-1.64**	**-1.64**

5.2.1 Sectoral Closures

The sectoral analysis identifies the different magnitudes of the outcomes according to the sector in which the shock takes place. We also check whether all sectors follow the trend described above in the "All divestments" simulations. Note that the last row in Table 4 gives the results also used in Figure 1, to aid comparison. The variables are those considered in the previous section.

The biggest reductions in employment are observed after the closure of plants in "Motor vehicles, trailers and semi-trailers" (Motor vehicles, henceforth) and in "Telecommunications", with reductions of 0.46% and 0.36% in total employment, respectively. The most sizeable increases in the unemployment rate occur after the shock in those two sectors. However, there is a fall in the rental rate of capital in Telecommunications (0.12%), but an increase for Motor vehicles (0.14%) (Note that Telecommunications is more capital intensive, Figure 2). This implies that the fall in GDP and welfare are the largest after the closures in Telecommunications (0.41% and 0.43%, respectively). The next most harmful effects arise after closures in Motor vehicles (0.35% in GDP and 0.42% in welfare). The fall in foreign trade is greatest after the shock in the latter sector, characterised by the international openness of its activities.

Although differing in magnitudes, all sectors follow the trend described earlier when analysing the "Closure" hypothesis in "All divestments". Only "Activities auxiliary to financial intermediation" have different outcomes for employment, unemployment and wages. This is related to the fact that the amount of labour affected in the shock in this sector is much smaller than that affected after the shock in the other sectors. It is easier to reallocate a smaller quantity of labour throughout the economy, so adjustment costs are lower.

In general, the differences in the magnitude of the impact of closures across sectors are related to the amount of capital involved in the shock. This is a combination of the weight of MNEs in the capital stock of the sector, as well as how labour intensive they are, together with the magnitude of the decrease in the net FDI position.

5.2.2 National acquisitions across sectors

Telecommunications is also the sector to undergo the most adverse effects on GDP when national acquisitions take place (Table 5). There is still a fall in GDP, although smaller than in the case of closures (0.27% versus 0.41%). In fact, national acquisitions in most sectors result in small GDP decreases. After Telecommunications, the next largest falls come from "Other business activities" and Motor vehicles. In most cases, national acquisitions increase employment and wages and reduce unemployment. This trend should be familiar, since we also observe it in "All divestments" ("National acquisition" hypothesis), shown in the last row of Table 5. However, it is the fall in the real rental rate of capital which brings about the negative results in GDP. Note that with the national acquisitions the remuneration of capital falls by more than in the case of closures (as reported in Table 4). In the case of "closures" capital becomes less abundant in the country, while with national acquisitions the total stock of capital remains fixed (although there is a change in ownership). These forces meant that capital will be relatively more expensive when it becomes less abundant (i.e., "closure" case). Further, the reduction in the rental rate of capital after national acquisitions in the short run is supported by empirical evidence. Anand et al. (2005) argue that firms experience difficulties in their post-acquisition performance, further stressing that wider geographic scope in post-acquisition would be helpful. Note that the "National acquisition" case would commonly reduce the geographic scope of the activities of the firm, compared to the previous case where the plant was part of an MNE. Hennart (2009: 1445) also explains that there is a cost in managing integration, which provides a rationale for the national acquisition losses.

For manufacturing sectors the outcome of the higher level of activity in national firms is that the fall in foreign trade is smaller than in the case of closures. However, for services, when more activities are undertaken in national firms, the fall in foreign trade is larger than in the case of closures. More activity in national firms in services contracts foreign trade.

National acquisitions in Motor vehicles exhibit a different pattern because it is relatively labour intensive. The same phenomenon (i.e., MNEs being even more labour intensive than national firms) occurs in "Other business". However, the latter sector accounts for an important part of consumption and is therefore simultaneously linked to the demand side of the economy. Thus, costs are not very

important for changes in this sector. Changes in costs are important for the development of "Sale and repair of motor vehicles" and, to a lesser extent, of "Renting of machinery and equipment". MNEs in the former sector are very capital intensive compared with national firms. When foreign capital leaves, capital is invested in national acquisitions, where it generates a boom in employment, leading to a decrease in unemployment. "Sale and repair of motor vehicles" is the only sector in which national acquisitions bring about a GDP increase. In agreement with previous results derived from the arrival of MNEs (Latorre et al. 2009; Latorre 2013), these sectoral differences in the impact of "National acquisition" indicate that cost structures are important to explain the outcomes.

6 Sensitivity Analysis

A sensitivity analysis on model elasticities for all scenarios has been performed. Table 6 shows the results for a selected group of macroeconomic variables focused on labour market effects: employment, unemployment rate and wages. These variables can be considered a good example of the sensitivity of the results to the whole set of elasticities. The results relate to the scenario "All divestments" for the two types of change in capital stock: "National acquisitions" and "Closures". The full set of results for the remaining microeconomic and macroeconomic variables and scenarios has been omitted here and can be requested from the authors.

The sensitivity analysis focuses on the elasticities related to the welfare and production functions. The baseline scenario "All divestments" for "National acquisitions" and "Closures" is shown in the first line in Table 6. The benchmark elasticities have been duplicated and halved, except for the Armington elasticities[3] (where a more competitive international framework has been tested) and β (where very rigid and flexible wage scenarios have been tested).

[3] Anderson and van Wincoop (2004) review the literature on the Armington elasticities and find values between 5 and 10 more plausible than the lower GTAP estimates used in this paper. The sensitivity analysis adopts an intermediate value of 7.5 for all sectors.

Table 6: Sensitivity analysis

	National Acquisitions			Closures		
	Employment	**Unemployment rate**	**Wages**	**Employment**	**Unemployment rate**	**Wages**
Base: All divestments	1.00	-3.55	0.24	-1.49	11.00	-0.74
Elasticity of substitution between savings and consumption (σCA = 1)						
σ'CA = 2	0.99	-3.60	0.24	-1.50	10.99	-0.74
σ'CA = 0.5	1.00	-3.52	0.24	-1.48	11.00	-0.74
Elasticity of substitution between consumption and leisure (σCO = 1)						
σ'CO = 2	0.89	-6.37	0.43	-1.74	8.08	-0.54
σ'CO = 0.5	1.06	-1.87	0.13	-1.34	12.62	-0.85
Elasticity of substitution among consumption godos (σBC = 1)						
σ'BC = 2	1.09	-3.47	0.23	-1.64	12.25	-0.82
σ'BC = 0.5	1.00	-3.67	0.25	-1.28	9.53	-0.64
Elasticity of substitution between labour and capital (σLK = Narayanan and Walmsley, 2008)						
σ'LK = σLK * 2	0.99	-3.43	0.23	-1.75	12.53	-0.84
σ'LK = σLK * 0.5	1.00	-3.55	0.24	-1.27	9.79	-0.66
Armington trade elasticity (σ'A = Narayanan and Walmsley, 2008)						
σ'A = 7.5	0.25	-1.35	0.09	-0.67	5.36	-0.36
Real wage flexibility with respect to the unemployment rate (β = 1.5)						
β' = 0.001	0.71	-0.01	0.56	-0.38	0.01	-1.35
β' = 20	1.18	-5.85	0.03	-2.62	22.18	-0.11

With respect to "National acquisitions", the shocks in the elasticity of substitution between aggregate consumption and savings hardly affect the results. The change in the elasticity of substitution between consumption and leisure affects the labour supply and, logically, this is reflected in employment, unemployment rate and wages. A higher (lower) elasticity of substitution consumption-leisure exacerbates (dampens) the changes in those variables. Differences are in quantitative terms, but not in signs. The elasticity of substitution among consumption goods has a small effect on labour market variables. The elasticity of substitution capital-labour affects the capital and labour demands. Nevertheless, the labour market variables are not significantly affected. The higher Armington elasticity indicates that more competitive goods markets temper adjustments in the labour market. Finally, a lower β parameter (i.e., a very flexible wage scenario) and a higher β (i.e., a very rigid wage scenario) show the expected results: a lower (higher) β generates a lower (higher) change in employment and unemployment and higher (lower) wage adjustment.

The "Closures" simulations follow a similar pattern to the previous "National acquisitions" case. Although signs with respect to the baseline case are maintained in all the cases given in Table 6, it shows a slightly higher effect in quantitative terms. This can be explained because of the fall in capital endowments. With a smaller amount of capital, effects on the other factor (labour) should be stronger.

7 Concluding Remarks

The FDI inflows received in the Spanish economy outweighed the amount of total divestments (i.e., reductions in the net FDI inward position) in the period 2005–2009. However, in some particular sectors, MNEs' divestments surpassed their investments.

In this paper, we first work on the data available to estimate the magnitude of sectoral divestments in an attempt to isolate those that lead to a reduction in production and employment in MNEs. We find these to be sizeable in some Spanish sectors. In order to analyse the effects of these divestments, we develop a CGE model which considers the presence of both MNEs and unemployment. As far as we know, there is no other study using a CGE model with unemployment and MNEs. We estimate the economy-wide impact of divestments, presenting

results for total employment, the rate of unemployment, real wages, capital remunerations, GDP, welfare and foreign trade.

Fortunately for the Spanish economy, foreign divestments have not always resulted in the closure of plants but in the acquisition of foreign plants by national firms. The World Investment Report published by UNCTAD shows that this predominance of national acquisitions is a general trend across countries. We pay close attention to this matter by estimating two different hypotheses ("Closure" versus "National acquisitions"). The real outcome should be between these two extreme cases.

Taking into account all simultaneous divestments in the ten sectors where they have concentrated between 2005 and 2009, we obtain the following main outcomes for the short and medium run. For "Closures", the unemployment rate would increase from 9.16% (its 2005 level) to 10.16%, and GDP would decrease by –1.45%. In the case of "National acquisitions", the unemployment rate would be reduced from 9.16% to 8.83%, and GDP would remain approximately at its initial level. This suggests that "Closures" would only have accounted for a very small share of the huge increase in unemployment that Spain has recently experienced (from 8.4% in 2005 to 26% in 2012), even though they could have been more important to explain the fall in GDP in 2009 (–3.7%) and 2010 (–0.3%).

We also analyse the differential impact of divestments at sectoral level. The shocks are asymmetric insofar as they simulate the real magnitudes of sectoral divestments for the period 2005–2009. We analyse the impact in both manufacturing and service sectors. In the "Closure" scenario, divestments in "Telecommunications" and "Motor vehicles" would bring about the most substantial increases in the unemployment rate and decreases in GDP. For "National acquisition", the greatest reductions in unemployment would occur in "Sale and repair of motor vehicles", "Renting of machinery and equipment", "Activities auxiliary to financial intermediation" and "Air and water transport". Regarding GDP outcomes (in the "National acquisition" case) only "Sale and repair of motor vehicles" yields an increase in GDP, while it is slightly reduced in the other nine sectors. For most sectors, the different outcomes of divestments are related to the contrasting cost structures of MNEs across sectors.

It could be expected *a priori* that national acquisitions of foreign MNEs would benefit the host economy. Our analysis shows that this is the case in terms of unemployment reductions and employment creation. However, due to the impact

of national acquisitions on capital remuneration (i.e., on firms' profits), welfare tends to diminish in the host economy. Additionally, GDP could also fall in some cases. In this sense, our results contrast with the optimistic view of divestments presented by Myro et al. (2008) based on econometric estimations for the years of the construction boom in Spain. While we cover the final years of the construction boom and the beginning of the crisis, we share those authors' view that the scope of the phenomenon is rather limited, but we find more potential for damaging impacts. Sectoral divestments clearly have a considerable negative effect on the Spanish economy when they take the form of closures. They also have some harmful effects (decrease in welfare and GDP), as well as positive outcomes on employment creation and unemployment reduction, in the case of national acquisitions.

This paper provides detailed quantitative estimations of the processes related to divestments that could be helpful to the implementation of compensating policy options.

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Appendix I: Sectors in the model and their correspondences with different sectoral classifications.

	Spanish Input-output Table (2005)	NACE Rev. 1	Nace Rev.2
Primary goods	1,2,3	01,02,05	01,02,03
Energy	8,9,10	23,04	19,35
Food products	12,13,14	15 (except 159)	10
Beverages & Tobacco	15,16	159,16	11,12
Textiles products	17,18,19	17,18,19	13,14,15
Chemical products	23,24	24,25	20,21,22
Basic metals	29,31	27,29	24,28
Manufacture of metal products	30	28	25
Motor vehicles, trailers & semi-trailers	36	34	29,3311,3315,3316,3317
Other industries	4,5,6,7,11,20,21,22,25,26,27,28, 32, 33,34,35,37,38,39	10,11,12,13,14,41,36,20,21,22, 26,30,31,32,33,25,36,37	05,06,07,08,09,36,16,17, 18,23,26,27,30,31
Contruction	40	45	41,42,43
Sale & repair of motor vehicles and automotive fuel	41	50	45
Wholesale and retail trade	42,43	51,52	46,47,95
Air and water transport	48,49	61,62	50,51
Other transport	46,47,50,51	60,63	49,52,79
Post and telecommunications	52	64	53,61
Financial intermediation	53,54	65,66	64,65
Activities auxiliary to financial intermediation	55	67	66
Real estate activities	56	70	68
Renting of machinery & equipment	57	71	77
Other business activities	60	74	69,70,71,73,74,78,80,81,82
Other services	44,45,58,59,61,62,63,64,65,66,71,72	55,56,72,73,80,85,90,91,92,93	55,56,58,62,63,72,85,75,86,87,88, 37,38, 39,94,59,60,90,91,92,93,96
Public services	67,68,69,70	75,80,85,90	84,97

Appendix II: Model equations

As general rule, the notation in the model is as follows: endogenous variables are denoted by capital letters, exogenous variables by capital letters with a bar, and parameters by small Latin and Greek letters. There are 23 (i, j = 1,…, 23) production sectors and each sector produces one good. The model's equations are as follows, and variables and parameters are listed below.

A. 1. Production

The nested technology presents constant returns to scale and a competitive pricing rule. Given that the top nest is a Leontief function, the zero-profit condition for domestic firms and MNEs in sector i are, respectively:

$$PROFIT_i^{X\_DOM} = PX\_DOM_i - c\_dom_{0i}PVA\_DOM_i - \sum_{j=1}^{23} c\_dom_{ji}PO_j\left(1+TAU.it_i^{II}\right) = 0$$

$(i = 1,\ldots, 23)$ **(A1)**

$$PROFIT_i^{X\_MNE} = PX\_MNE_i - c\_mne_{0i}PVA\_MNE_i - \sum_{j=1}^{23} c\_mne_{ji}PO_j\left(1+TAU.it_i^{II}\right) = 0$$

$(i = 1,\ldots, 22)$ **(A2)**

where, according to the nested structure, the unitary cost of the value added composite generated by sector i is a CES function:

$$PVA\_DOM_i = \frac{1}{\alpha\_dom_i}\left(a\_dom_i^{\sigma_i^{LK}}\left(1+soc_i\right)^{1-\sigma_i^{LK}} W^{1-\sigma_i^{LK}} + \left(1-a\_dom_i\right)^{\sigma_i^{LK}} R\_DOM_i^{1-\sigma_i^{LK}}\right)$$

$(i = 1,\ldots, 21)$ **(A3)**

$$PVA\_MNE_i = \frac{1}{\alpha\_mne_i}\left(a\_mne_i^{\sigma_i^{LK}}\left(1+soc_i\right)^{1-\sigma_i^{LK}} W^{1-\sigma_i^{LK}} + \left(1-a\_mne_i\right)^{\sigma_i^{LK}} R\_MNE_i^{1-\sigma_i^{LK}}\right)$$

$(i = 1,\ldots, 21)$ **(A4)**

$$PVA\_DOM_i = \frac{1}{\alpha\_dom_i}\left(\begin{array}{l} a\_dom_i^{\sigma_i^{LK}}\left(1+soc_i\right)^{1-\sigma_i^{LK}} W^{1-\sigma_i^{LK}} + \\ \left(1-a\_dom_i\right)^{\sigma_i^{LK}}\left(aa\_dom_i R\_DOM + \left(1-aa\_dom_i\right) R\_PUB\right)^{1-\sigma_i^{LK}} \end{array}\right)$$

($i = 22$) **(A5)**

$$PVA\_MNE_i = \frac{1}{\alpha\_mne_i}\left(a\_mne_i^{\sigma_i^{LK}}\left(1+soc_i\right)^{1-\sigma_i^{LK}} W^{1-\sigma_i^{LK}} + \left(1-a\_mne_i\right)^{\sigma_i^{LK}} R\_MNE^{1-\sigma_i^{LK}}\right)$$

($i = 22$) **(A6)**

$$PVA\_DOM_i = \frac{1}{\alpha\_dom_i}\left(a\_dom_i^{\sigma_i^{LK}}\left(1+soc_i\right)^{1-\sigma_i^{LK}} W^{1-\sigma_i^{LK}} + \left(1-a\_dom_i\right)^{\sigma_i^{LK}} R\_PUB_i^{1-\sigma_i^{LK}}\right)$$

($i = 23$) **(A7)**

There is imperfect substitution between production made by domestic firms and MNEs. This is modelled through an Armington aggregate:

$$PROFIT_i^X = PX_i - \left(ax_i^{\sigma_i^A} PX\_DOM_i^{1-\sigma_i^A} + \left(1-ax_i\right)^{\sigma_i^A} PX\_MNE_i^{1-\sigma_i^A}\right)$$

(i=1,…,22) **(A8)**

We assume that firms maximize profits, and choose the optimal mix of national and imported goods, and that of domestic sales and exports. This leads to the next zero profit conditions:

$$PROFIT_i^A = PA_i - \left(e_i^{\sigma_i^A} PX_i^{1-\sigma_i^A} + \left(1-e_i\right)^{\sigma_i^A}\left(\overline{PFXCUR}\right)^{1-\sigma_i^A}\right)^{\frac{1}{1-\sigma_i^A}}$$

($i = 1,\ldots, 23$) **(A9)**

$$PROFIT_i^{CET} = PA_i - \frac{1}{\zeta_i}\left(d_i^{-\varepsilon_i} PO_i^{\varepsilon_i+1} + \left(1-d_i\right)^{-\varepsilon_i}\left(\overline{PFXCUR}\right)^{\varepsilon_i+1}\right)^{\frac{1}{\varepsilon_i+1}}$$

(i=1,…,23) **(A10)**

These zero profit conditions are used to get derived demand functions, by applying the Shepard's Lemma on cost functions.

Next, we introduce the corresponding market clearing equations, with demands and supplies showing in the left-hand and the right-hand side, respectively:

$$X\_DOM_i\left(-\frac{\partial PROFIT_i^{X\_DOM}}{\partial PO_j}\right)+X\_MNE_i\left(-\frac{\partial PROFIT_i^{X\_MNE}}{\partial PO_j}\right)=II_{ji}$$

$(i,j = 1,\ldots, 23)$ **(A11)**

$$X\_DOM_i\left(-\frac{\partial PROFIT_i^{X\_DOM}}{\partial R\_DOM_i}\right)=\overline{K_i^{RC\_DOM}} \quad (i = 1,\ldots, 23) \quad \textbf{(A12)}$$

$$X\_MNE_i\left(-\frac{\partial PROFIT_i^{X\_MNE}}{\partial R\_MNE_i}\right)=\overline{K_i^{RC\_MNE}} \quad (i = 1,\ldots, 22) \quad \textbf{(A13)}$$

$$X\_DOM_i\left(-\frac{\partial PROFIT_i^{X\_DOM}}{\partial R\_PUB_i}\right)=\overline{K_i^{PUB}} \quad (i = 22, 23) \quad \textbf{(A14)}$$

$$\sum_{i=1}^{23}\left(X\_DOM_i\left(-\frac{\partial PROFIT_i^{X\_DOM}}{\partial W}\right)+X\_MNE_i\left(-\frac{\partial PROFIT_i^{X\_MNE}}{\partial W}\right)\right)=\left(\overline{L}-Q_l\right)(1-U)$$

(A15)

$$X_i\left(-\frac{\partial PROFIT_i^{X}}{\partial PX\_DOM_i}\right)=X\_DOM_i \quad (i = 1,\ldots, 23) \quad \textbf{(A16)}$$

$$X_i\left(-\frac{\partial PROFIT_i^{X}}{\partial PX\_MNE_i}\right)=X\_MNE_i \quad (i = 1,\ldots, 22) \quad \textbf{(A17)}$$

$$A_i\left(-\frac{\partial PROFIT_i^A}{\partial PX_i}\right) = X_i \qquad (i = 1,\ldots, 23) \qquad \textbf{(A18)}$$

$$A_i\left(-\frac{\partial PROFIT_i^A}{\partial FC_i}\right) = IMP_i \qquad (i = 1,\ldots, 23) \qquad \textbf{(A19)}$$

$$A_i\left(-\frac{\partial PROFIT_i^{CET}}{\partial PO_i}\right) = O_i \qquad (i = 1,\ldots, 23) \qquad \textbf{(A20)}$$

$$A_i\left(-\frac{\partial PROFIT_i^{CET}}{\partial FC_i}\right) = EXP_i \qquad (i = 1,\ldots, 23) \qquad \textbf{(A21)}$$

$$X_i = X\_DOM_i + X\_MNE_i \qquad (i = 1,\ldots, 23) \qquad \textbf{(A22)}$$

$$X_i + IMP_i = O_i + EXP_i \qquad (i = 1,\ldots, 23) \qquad \textbf{(A23)}$$

$$I_i + \sum_{i=1}^{23} II_{ij} + FC_i = O_i \qquad (i = 1,\ldots, 23) \qquad \textbf{(A24)}$$

A. 2. Consumption

The final demand functions are derived from the maximization of the representative consumer's nested welfare function:

$$WF = \left(Q_c\right)^{1-\tau_{SAV}}\left(Q_{sav}^{priv}\right)^{\tau_{SAV}} \qquad \textbf{(A25)}$$

subject to the budget constraints:

$$Y_{RC} = W\left(\overline{L} - Q_l\right)(1-U) + \sum_{i=1}^{23} R\_DOM_i\,\overline{K_i^{RC\_DOM}} + \sum_{i=1}^{22} R\_MNE_i\,\overline{K_i^{RC\_MNE}} + \overline{NTPS}$$

(A26)

$$Y_{RC} = PRIVSAV + \sum_{i=1}^{22} PO_i\left(1 + TAU.it_i^{FC}\right)FC_i^{RC} \qquad \textbf{(A27)}$$

where:

$$PRIVSAV = P_{sav}Q_{sav}^{priv}$$

The nests in the welfare function are defined by:

$$Q_c = \left(b^{\sigma^{CL}} Q_{cg}^{1-\sigma^{CL}} + (1-b)^{\sigma^{CL}} Q_l^{1-\sigma^{CL}}\right)^{\frac{1}{1-\sigma^{CL}}} \qquad \textbf{(A28)}$$

$$Q_{cg} = \prod_{i=1}^{22}\left(FC_i^{RC}\right)^{\tau_i} \qquad \textbf{(A29)}$$

Consumption goods are purchased by the representative consumer and the public sector:

$$FC_i = FC_i^{RC} + FC_i^{PUB} \qquad (i = 1,\ldots, 23) \qquad \textbf{(A30)}$$

The solution to the maximization problem yields the demand functions for savings, leisure, and final demand.

A. 3. Public Sector

The income of the public sector is given by:

$$Y_{PUB} = \sum_{i=22,23} R\_PUB_i\overline{K_i^{PUB}} + \sum_{i=1}^{23}\left(SOC_i + IT_i\right) - \overline{NTPS} \qquad \textbf{(A31)}$$

where revenues come from several taxes:

$$SOC_i = Wsoc_i\left(X\_DOM_i\left(-\frac{\partial PROFIT_i^{X\_DOM}}{\partial W}\right) + X\_MNE_i\left(-\frac{\partial PROFIT_i^{X\_MNE}}{\partial W}\right)\right)$$

$(i = 1,\ldots, 23)$ **(A32)**

$$IT_i = TAU.it_i^{II}\left(\begin{array}{l} PX\_DOM_i X\_DOM_i\left(-\frac{\partial PROFIT_i^{X\_DOM}}{\partial PO_i}\right)+ \\ PX\_MNE_i X\_MNE_i\left(-\frac{\partial PROFIT_i^{X\_MNE}}{\partial PO_i}\right) \end{array}\right) + PO_i I_i TAU.it_i^{GKF} + PO_i FC_i TAU.it_i$$

$(i = 1,\ldots, 23)$ **(A33)**

The macro closure rule is:

$$Y_{PUB} - \sum_{i=1}^{23} PO_i\left(1 + TAU.it_i^{FC}\right)FC_i^{PUB} = PUBSAV \quad \textbf{(A34)}$$

where:

$$PUBSAV = P_{sav}Q_{sav}^{pub}$$

A. 4. Foreign sector, investment and savings

The macro closure of the model involves some other constraints related to investment and savings in this open economy:

$$\sum_{i=1}^{23} \overline{PFXEXP_i} + \overline{FORSAV} = \sum_{i=1}^{23} \overline{PFXIMP_i} \quad \textbf{(A35)}$$

$$PRIVSAV + PUBSAV + \overline{FORSAV} = \sum_{i=1}^{23} PO_i\left(1 + TAU.it_i^{GKF}\right)I_i \quad \textbf{(A36)}$$

A. 5. Factor Markets

The equilibrium in the capital market is given in **(A6)**, and the equilibrium in the labour market in **(A7)**, with some restrictions related to the unemployment assumptions:

$$\frac{W}{CPI} = \left(\frac{1-U}{1-\overline{U0}} \right)^{\frac{1}{\beta}} \quad \textbf{(A37)}$$

$$CPI = \frac{\sum_{i=1}^{23} \theta_i PO_i}{\sum_{i=1}^{23} \theta_i \overline{PO_i}} \quad \textbf{(A38)}$$

Table A1. Endogenous Variables

Symbol	Definition
A_i	Armington aggregate (total amount of goods supplied) of sector *i*
CPI	Consumer Price Index
CUR	Factor of conversion of foreign currency into domestic currency
EXP_i	Exports of sector *i*
FC_i	Final domestic consumption of goods produced by sector *i*
FC_i^{RC}	Final private consumption of goods produced by sector *i*
FC_i^{PUB}	Final public consumption of goods produced by sector *i*
I_i	Investment (gross capital formation) in goods produced by sector *i*
II_{ij}	Intermediate inputs from sector *j* used by sector *i*
IMP_i	Imports from sector *i*
IT_i	Indirect taxes revenue in sector *i*
O_i	Production of sector *i* sold in the domestic market
P_{sav}	Savings shadow price
PA_i	Unit cost of the Armington aggregate of sector *i*
PO_i	Unit cost of the production of sector *i* sold in the domestic market
$PRIVSAV$	Private savings
$PROFIT_i^A$	Unit profits for A_i (according to origin)
$PROFIT_i^{CET}$	Unit profits for A_i (according to destination)

$PROFIT_i^X$	Unit profits for X_i
$PROFIT_i^{X\_DOM}$	Unit profits for X_DOM_i
$PROFIT_i^{X\_MNE}$	Unit profits for X_MNE_i
$PUBSAV$	Public savings
$PVA_i^{X\_DOM}$, $PVA_i^{X\_MNE}$	Unit cost of primary inputs used by domestic and MNEs firms in sector *i*
PX_i	Price of the goods produced by sector *i*
PX_DOM_i	Price of the goods produced by domestic firms in sector *i*
PX_MNE_i	Price of the goods produced by MNEs in sector *i*
Q_c	Demand for aggregate consumption
Q_{cg}	Demand for aggregate consumption of goods
Q_l	Demand for leisure
$Q_{sav}^{priv}, Q_{sav}^{pub}$	Private and Public demand for savings
R_DOM_i, R_MNE_i R_PUB_i	Capital rental rates in sector *i*
SOC_i	Revenue from social contributions paid by employers and employees of sector *i*
TAU	Endogenous multiplier for revenue neutrality
U	Unemployment rate
W	Wages
WF	Welfare
$X_i, X\_DOM_i,$ X_MNE_i	Production of sector *i*
Y_{RC}	Disposable income of the representative consumer
Y_{PUB}	Disposable income of the public sector

Table A2. Exogenous Variables and Parameters

Symbol	Definition
$\overline{FORSAV}$	Foreign savings
$\overline{K_i^{RC\_DOM}}, \overline{K_i^{RC\_MNE}}$	Capital endowment of the representative consumer to produce good *i*
$\overline{K_i^{PUB}}$	Capital endowment of the public sector to produce good *i*
$\overline{L}$	Labour endowment
$\overline{NTPS}$	Net transfers from the representative consumer to the public sector
$\overline{PFX}$	World prices
$\overline{PO_i}$	Benchmark Prices
$\overline{U0}$	Benchmark Unemployment rate
a_dom_i, a_mne_i, aa_dom_i, ax_i, b, c_dom_{0i}, c_mne_{0i}, c_dom_{ji} c_mne_{ji}, d_i, e_i	Share parameters
$it_i^{II}, it_i^{GKF}, it_i^{FC}$	Indirect taxes rates, *ad valorem*, in sector *i*, that burden intermediate inputs, investment and final consumption, respectively
soc_i	Social contributions rates, *ad valorem*, paid in sector *i*
$\alpha\_dom_i, \alpha\_mne_i$ ζ_i	Scale parameters
β	Sensibility parameter real wages-unemployment rate
ε_i	Elasticity of transformation in sector *i*
θ_i	Share parameters
σ_i^A	Armington elasticity of substitution in sector *i*
σ^{CL}	Elasticity of substitution between consumption and leisure
σ_i^{LK}	Elasticity of substitution between labour and capital in sector *i*
τ_i, τ^{sav}	Share parameters